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ABSTRACT

This study was designed to determine the effectiveness of a student-centered approach in teaching the basic concepts of elementary mathematics to teacher preparation students, as utilized in the Mid-Career Training for Partnership Teaching (MTPT). The research formulated three hypotheses: a) students in the MTPT would show a significant increase in the knowledge of elementary school mathematics; b) the increase in this knowledge by MTPT students would compare favorably with the increase shown by students in typical preservice and in-service teacher education programs; and c) the level of knowledge possessed by MTPT students would compare favorably with the general population of elementary school teachers. MTPT students represented the student-goal-determined (SGD) approach and the preservice students represented the instructor-goal-determined (IGD) approach. Elementary school teachers represented the norm. The pre- and posttest data on all three groups were provided by the Callahan Test of Mathematical Knowledge. Results showed that both SGD and IGD participants increased their knowledge of mathematics and this growth was significantly higher than the norm group. (Four tables of statistical data are included.) (BRB)

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A Quasi-Experimental Study Designed To Evaluate the Effectiveness of a Student-Goal-Determined Course in Mathematics Education

SP 006 321

From the very beginning of the elementary school, educators have not been satisfied that each child has been dealt with most effectively to insure full utilization of whatever potential he possesses. This dissatisfaction has lead to many changes within the structure of the elementary school. Some of the earlier experiments in school organization were the St. Louis Plan (1868), Multi-Track Grouping (1889), the Dalton Plan (1919), and the Winnetka Plan of the 1920's. Today, schools such as the Oak Leaf School in Pittsburgh, The Nova School in Florida, and many others are continually experimenting with school curricula and administration. In some parts of the nation, nongraded schools, individualized reading programs, linguistics, I.P.I., self-directed programs, television teaching, and other innovative techniques designed to deal more effectively with the individual are much in evidence.

One question asked by both educators and critics is: Are the end products of teacher education programs prepared (a) to utilize the

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ground work that these and other innovative programs have developed and (b) to continue to modify the school environment so as more adequately to meet individual needs? As educators, we are continually striving to provide children with the resources for individual and independent study. If we accept this philosophy, teacher education programs must allow participants to experience themselves the behaviors they are expected to develop in children.

One of the most promising experimental programs in teacher education, both innovative in terms of structure and realistic in terms of goals, is the Mid-Career Training for Partnership Teaching (MTPT), created with funds supplied by The New York State Education Department and sponsored by the School of Education in cooperation with University College, Syracuse University.[1] The emphasis of this program differs greatly from that of the typical predesigned teacher education program. One of the first tasks for each participant is to write a paper stating his personal educational goals. By periodically reviewing, reevaluating, and rewriting the goal paper, he defines what his education is to consist of and specifies in behavioral terms the criterion he seeks. The staff of the MTPT then attempts to provide the student with a realistic method of reaching these goals. An underlying assumption of the MTPT program is that student-determined goals are more effective as motivators and should result in more efficient and pointed training than teacher-determined goals.

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1. A detailed description of the first year of the program may be found in Newman, Robert, and Pearson, Richard. The Mid-Career Teacher Education Study: Its First Year. Albany, N. Y.: State Education Department, 1968.

Problem

This study is designed to determine the effectiveness of utilizing a student-centered approach as a means through which teacher preparation students acquire the basic concepts of mathematics needed by the elementary school teacher, as defined by and measured with the Callahan Test of Mathematical Knowledge.[2]

The three questions to be studied are:

1. Do the students enrolled in the MTPT show significant growth in the knowledge of elementary school mathematics needed by today's elementary school teacher?

2. Does the relative growth of mathematical knowledge possessed by the MTPT students compare favorably with the relative growth of mathematical knowledge demonstrated by students in a more typically formal preservice and in-service teacher education program?

3. Does the level of mathematical knowledge possessed by the MTPT students compare favorably with the general population of elementary school teachers?

Design and Procedures

Subjects

(1) MTPT students enrolled in a student-goal-determined course in the Mid-Career Teacher Education Study at Syracuse University. The typical student was female, approximately thirty-four years of age, married, and holder of a B.S. or B.A. degree from an accredited institution.

(2) Preservice students enrolled in an instructor-goal-determined course at the undergraduate level. The typical student was female, twenty-two years of age, single, and had not completed requirements for a bachelor's degree.

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2. Callahan, Leroy G. "A Study of Knowledge Possessed by Elementary School Teacher, In-Service and In-Training, of the Cultural, Psychological, and Mathematical Foundation of the Elementary School Mathematics Program." Doctor's thesis. Syracuse, N. Y.: Syracuse University, 1966. (Unpublished)

(3) A normative group composed of a random sample of elementary school teachers who were teaching in New York State during the 1965-66 school year.

In the majority of the goal papers written by the MTPT students, a concern about mathematics education was clearly evident. Consequently, during April and May 1968, the students observed the teaching of mathematics in the public schools. However, in mid-June, they asked for help, and this led to the hiring of a mathematics consultant. After conferring with him as a group, the students decided to establish fifteen 1-hour periods (beginning in September 1968 and ending in January 1969) to pursue the study of mathematics. It was agreed that the fifteen sessions would be used in reacting to the students' questions, which were to be relayed to the consultant by means of weekly reaction sheets. In this way, the topics treated, and their sequence, would be determined by the students rather than by the consultant. Since attendance at the instructional periods was optional, they were tape-recorded in order to provide information for those students who might miss a session. On the belief that their needs and interests could be more fully met if they did not have to work for a grade, the students also decided that no grades would be given at the end of the course.

Definitions

(1) The student-goal-determined course, as operationally defined by the MTPT students, was one in which their reactions and suggestions set the major goals and determined the content, sequence, time, and evaluation procedures for the course.

(2) The instructor-goal-determined course was one in which the major goals were determined by the instructor with no prior consultation with the students; hence, his

goals determined the topics and sequence of the course. The instructor-determined goals were, of course, strongly influenced by state certification and university requirements, as well as by his professional judgment. As with most such courses, attendance was required, class time was predetermined, and tests were used for evaluation and grading.

(3) Instructional time consisted of only prescheduled instructional hours.

(4) The independent variable in this study was course structure. The two types of structure studied were the student-goal-determined and the instructor-goal-determined courses. The major difference between them was the source of the goals.

(5) The dependent variable was mathematical knowledge. This study was concerned not only with the final level of mathematical knowledge of the subjects but also with their growth. Growth is defined as the posttest minus the pretest score; the final level of mathematical knowledge, as the posttest score. The dependent variable was measured by the Callahan Test of Mathematical Knowledge.

Procedures

The experimental groups were randomly selected from the available populations: for the IGD, one of four scheduled sections was selected; for the SGDC, there was only one section of 33 people available, of whom 25 were randomly selected for the group. The two groups were instructed during the fall semester, 1968-69. The SGD students had fifteen 1-hour sessions; the IGD students, thirty-one and one-half 1-hour sessions. Both were administered the Callahan Test, Form A, at their first meeting, as a pretest; and the Callahan Test, Form B, at their last instructional session, as a posttest. The instructors held doctoral degrees, with specialties in mathematics education, and had previously taught similar content courses at the undergraduate level.

Results

Since these experimental groups were non-random populations, it is not appropriate to use inferential statistics in analyzing the data gathered during this study; therefore, descriptive statistics will be used to support or negate the hypothesis previously stated.

Table 1 presents the comparison between the pretest and posttest scores of the SGD and the IGD students. As indicated in the table, the growth (percent of pre-post mean difference) for each experimental group is greater than 10, which, according to Brownell,[3] is educationally significant.

Table 1

Comparison of the Growth Between the Pretest and the Posttest Scores of the SGD and the IGD Students on the Callahan Test of Mathematical Knowledge[4]

Group	Pretest Mean	Pretest S.D.	Posttest Mean	Posttest S.D.	Mean Diff.	Mean Difference as Percent
SGD students	24.0	4.16	31.48	4.96	7.48	+17.25
IGD students	28.05	4.01	34.90	3.30	6.85	+15.87

3. Brownell, William A. Arithmetical Abstractions: The Movement Toward Conceptual Maturity Under Differing Systems of Instruction. U.S. Department of Health, Education, and Welfare, Office of Education, Cooperative Research Project No. 1676. Berkeley: University of California, 1964. pp. 53-55.

4. The Callahan Test consists of forty-four items.

It can be seen from Table 2 that the means, medians, standard deviations, and range of the two experimental groups are different. However, it should be noted that, although differences between the groups exist, they appear to be minimal in terms of practical significance.

Table 2

Posttest Results of the Two Experimental Groups on the Callahan Test of Mathematical Knowledge

Group	N	X	S.D.	Median	Range
SGD students	25	31.5	4.96	31.25	22-41
IGD students	20	34.9	3.30	34.66	26-39

As can be seen from Table 3, the percent of mean difference between the posttest scores of each of the experimental groups and those of the normative group was of considerable magnitude. From this evidence, one can conclude that the experimental groups were substantially more knowledgeable in mathematics than was the normative group.

Table 3

Group	$\bar{X}$	S.D.	Normative Group $\bar{X}$	Normative Group S.D.	Mean Diff.	Mean Difference as Percent
SGD students	31.5	4.96	20.43	7.24	11.17	25.76
IGD students	34.9	3.30	20.43	7.24	14.47	33.15

The results of this study indicate that (1) there was growth in mathematical knowledge for both the SGD students and IGD students; (2) the two experimental groups, although different statistically (from a descriptive point of view), did not appear to be educationally different; and (3) the experimental groups at the end of the course in mathematics education were substantially more knowledgeable regarding mathematics than was the normative group. From this, it would appear that the SGD course in mathematics education is as effective as an IGD course.

Discussion

An important criterion for the evaluation of any educational program is the amount of time required for the presentation of a given topic. In this study, the instructional time varied greatly from one group to another due to the goal-setting procedures utilized: the SGD students received fifteen hours of instruction; the IGD students, forty-five. At the end of the course in mathematics education, the SGD students reported that they had spent 33.72 hours studying mathematics, counting seminars, class participation, observations, etc. This is roughly one hour of outside work for each hour of scheduled classroom instruction. It is interesting to note that although the SGD students' average hours of mathematics education totalled eleven hours less than the IGD instructional time the two experimental groups did not appear to be practically different in mathematical knowledge as measured by the Callahan instrument. The main reason for this nondifference would seem to be that the instruction provided the SGD students met an immediate and indicated need. In other words, the conditions for effec-

tive learning were met, thus compensating for the shorter length of instructional time.

From Table 4, which presents an analysis of five test items in geometry given to both groups on the Callahan instrument, it can be seen that the percentage of SGD students missing four out of the five items was much greater than that of the IGD students. An evaluation of reaction sheets submitted by the SGD students revealed that no reference was made by any of them to geometry, and consequently, no instruction was given in this subject. From this evidence, one may conclude that it may sometimes be the responsibility of an instructor in a student-goal-determined course to provide some guidance in the selection of topics to be discussed.

Table 4

An Item Analysis of Posttest Responses of the Two Experimental Groups to the Five Items on Geometry

	Percent of Students Missing Item	
Item Number	SGD Students	IGD Students
87	76	35
88	84	25
89	56	35
90	76	30
91	24	35

It is evident from a review of current research that mathematics education is in need of change. Although the findings of this study do not provide empirical evidence to support a specific direction for this change, it does offer some highly tentative patterns that are in

need of more rigorously controlled research. Some of the important questions left unanswered by this study include:

1. Will the SGD approach produce students more knowledgeable in mathematics than will the IGD approach, given equal time?

2. What is the relationship between an SGD course and teaching competency?

3. Does participation in an SGD course in mathematics have any effect on the participants' attitudes toward arithmetic?

4. Is the SGD approach an effective procedure in content areas other than mathematics?

As some of these questions are answered by further research, we must be prepared to justify and evaluate future changes in curriculum and methodology in light of these and other related findings.